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Broad perspectives in understanding vaccine hesitancy and vaccine confidence: an introduction to the special issue

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Abstract
The World Health Organization has designated vaccine hesitancy and vaccine confidence among the most pressing issues in global health. The COVID-19 pandemic has made vaccine hesitancy and vaccine confidence particularly salient and urgent. The purpose of this special issue is to highlight a broad range of perspectives on these critical issues. We have included a total of 30 papers that address issues related to vaccine hesitancy and vaccine confidence across multiple levels of the Socio-Ecological Model. We have organized the empirical papers into the following sections: individual-level beliefs, minority health and health disparities, social media and conspiracy beliefs, and interventions. In addition to the empirical papers, three commentaries are included in this special issue.

Keywords Vaccine hesitancy · Vaccine confidence · Health disparities · Vaccine beliefs · Interventions · Conspiracy beliefs · Social media

Introduction

The World Health Organization designated vaccine hesitancy and vaccine confidence as among the most pressing issues in global health (World Health Organization, 2019). Although some have defined vaccine hesitancy as delay in acceptance or refusal of vaccines despite availability of vaccine services (MacDonald, 2015), it may be more helpful to characterize hesitancy as a set of attitudes and beliefs associated with vaccine decision-making (Larson et al., 2022). Vaccine confidence, in contrast, refers to public trust in recommended vaccines as well as in the science, processes, and policies that led to their recommendation (USDHHS, 2021). The importance of vaccine hesitancy and vaccine confidence has become especially salient in the context of the COVID-19 pandemic and their importance will continue as new vaccines and vaccination schedules are developed to address new variants. Behavioral, communication, and implementation sciences are as important to understanding and intervening on vaccine hesitancy and improving confidence as biomedical science is to development of currently recommended vaccines for children, adolescents, and adults.

Bronfenbrenner's Socio-Ecological Model (SEM) provides a useful framework for identifying multi-level influences on vaccine hesitancy and confidence (Bronfenbrenner, 1979; Thompson et al., 2022). Applied to vaccination, individual influences may include knowledge, attitudes, and behavior. Interpersonal factors could involve perceived norms, health care provider recommendation, and the influence (positive or negative) of social media. Community factors are also important and may involve religious institution support (or non-support) of vaccination. At the health system level, implementation of policies such as standing orders and use of reminder-recall systems can have a positive impact on vaccination rates. Finally, government policies can be very influential, such as school-entry requirements or vaccine mandates for health workers. To achieve and maintain high vaccination coverage, it is important to study the influences on hesitancy and confidence at all levels of the SEM.

In this special issue, the papers address a broad range of issues and perspectives related to vaccine hesitancy and vaccine confidence, consistent with the SEM. Specifically,

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we have organized the empirical papers into the following sections: individual-level beliefs, minority health and health disparities, social media and conspiracy beliefs, and interventions to promote vaccination. Most of the papers are observational studies. Five papers report findings from message-based interventions designed to intervene on key targets of vaccine hesitancy. In addition to the empirical papers, three commentaries are included in this special issue. Consistent with the interpersonal level of the SEM, one of the papers discusses how psychotherapist self-disclosure of their own vaccination status could reduce vaccine hesitancy in their patients (Cannity, 2023). Another commentary addresses the multi-level influences on provider recommendations for vaccination, an approach entirely consistent with the SEM (Ellingson et al., 2023). The third commentary discusses the unique, multi-level factors that drive COVID-19 vaccine hesitancy among cancer survivors and the need for research to develop effective communication strategies to reach this vulnerable population (Vanderpool et al., 2023).

Individual-level beliefs

Determinants of vaccination exist at all levels of the SEM, yet vaccination is ultimately an individual behavior. Even parents and caregivers making vaccination decisions for their children involves individual-level decision-making. Understanding how individual-level beliefs are associated with vaccination is critical to understanding vaccine hesitancy and vaccine confidence.

The COVID-19 pandemic highlighted the importance of individual-level beliefs and decision-making. In the US, and in many other countries, COVID-19 vaccines were not widely delivered through health care providers during the first several months following authorization (Jan 2021–Aug 2021). As a result, there were few opportunities to leverage health care provider recommendations and discussions that often occur with vaccines delivered in primary care settings. Instead, most vaccines were distributed through public vaccination sites, requiring individuals to be sufficiently motivated to seek out the vaccines. Beliefs that are central to vaccination center around perceptions of the relevant health threat and of vaccine efficacy and safety (Betsch et al., 2018; Brewer et al., 2017; Gerend & Shepherd, 2012). Across different theoretical models, these beliefs are conceptualized as attitudes, confidence, various forms of risk perceptions, efficacy beliefs, and perceived barriers and constraints, among others. Determinants of these beliefs can be understood at multiple levels (e.g., individual-level information processing, social norms, public policies). During the pandemic, various factors have influenced beliefs about the vaccines, such as perceptions of the seriousness (i.e., vulnerability and severity) of COVID-19 and perceptions of vaccine safety and efficacy, including political messaging (Agarwal et al., 2021; Rosenthal & Cummings, 2021; Sherman et al., 2021).

The special issue includes seven papers that address various individual-level beliefs related to vaccine hesitancy and vaccine confidence. Most of the papers address beliefs about COVID-19 vaccines, although two examine beliefs in the context of seasonal flu vaccines. The papers address several critical issues to understanding the role of individual-level beliefs in vaccine hesitancy and vaccine confidence that will be important in guiding future research and communication strategies.

One critical issue that has emerged during the COVID-19 pandemic is the potential "spillover" effect of beliefs that contribute to COVID-19 vaccine hesitancy to beliefs about other vaccines. McCree et al. (2023) examined how beliefs about vaccines in general (i.e., 5 Cs; Betsch et al., 2018) were affected by the onset of the COVID-19 pandemic. Compared to those who enrolled pre-pandemic, participants enrolled after the onset of the pandemic reported lower levels of vaccine confidence and collective responsibility for vaccination. Both confidence and collective responsibility have been salient issues in the sociocultural context surrounding COVID-19 vaccines in the US and other countries (de Figueiredo et al., 2020). Potential "spillover" effects of the COVID-19 vaccine context to general vaccine hesitancy is an important issue for researchers and public health officials to understand and be prepared to address moving forward.

Another issue on individual-level beliefs that has become salient during the pandemic is hesitancy among vaccine adopters, an issue also identified with HPV vaccination (Walker et al., 2020). Willis et al. (2023) surveyed COVID-19 vaccine adopters immediately following receipt of a COVID-19 vaccine and 60% reported some level of hesitancy about getting the vaccine. Levels of hesitancy among these "hesitant adopters" varied across sociodemographic groups (age, sex, race/ethnicity/education). The existence of "hesitant adopters" has implications for the definition of vaccine hesitancy (i.e., not just behavioral) and is a key issue for messaging and interventions on vaccines that require individuals to make decisions about additional doses and boosters. Research that can unpack the dynamic nature of beliefs and hesitancy *post*-vaccination will be needed.

The issue of vaccine mandates and individuals' responses to them re-emerged as a key issue in vaccine hesitancy and vaccine confidence during the COVID-19 pandemic. Harris et al. (2023) examined predictors of vaccine mandate acceptance among COVID-19 vaccine acceptors, individuals opting to "wait-and-see", and non-acceptors. Respondents differentiated support for mandates for health care workers and travelers from mandates for adults generally, as there was more general support for mandates among health care workers and travelers. Understanding predictors of mandate

endorsement, and nuances around them, is critical for effective policy design, communication, and implementation.

Papers included in the special issue address two other issues that are important in guiding future research and interventions on individual-levels belief. First, questions about "for whom" or "under what conditions" do key associations exist (e.g., moderating variables) are important to consider in vaccine hesitancy. Gillman et al. (2023) examine how the uncertainty associated with the COVID-19 pandemic influenced trust in information and vaccine decision-making. They observed that uncertainty about COVID-19 did not directly affect trust in information. However, among individuals with lower tolerance for risk and ambiguity, perceptions of uncertainty about COVID-19 were associated with lower trust in COVID-19 information. Shook et al. (2023) report retrospective and prospective findings that individuals with higher levels of disgust proneness are more likely to receive a seasonal flu vaccine. Understanding which individuals are more likely to vaccinate and under what combination of beliefs is the likelihood of vaccination greater has important implications for communication about disease prevention and identifying for whom certain intervention approaches might be most effective.

Second, as young, emerging adults transition to their own decision-making about vaccination, it is important to understand hesitancy among this population. Using the Reasoned Action Approach (RAA; McEachan et al., 2016) variables among US college students to predict seasonal flu vaccine uptake (pre-COVID-19), Mongeau et al. (2023) observed that many RAA predictors were consistent with prior research, but past vaccination behavior did not predict uptake. Guided by the Extended Parallel Process Model (Maloney et al., 2011), Roberto et al. (2023) examined COVID-19 vaccine uptake among US college students. Those hesitant about COVID-19 vaccines reported low levels of susceptibility, severity, and vaccine efficacy. These findings are important for understanding messaging and interventions among young, emerging adults and raise the interesting possibility that some factors (e.g., past vaccination behavior) may be less influential among populations transitioning to their own decision-making.

Minority health and health disparities

Eight papers in this special issue address vaccine hesitancy and vaccine confidence among minority and other groups (i.e., grocery store workers, mothers). Understanding determinants of vaccine hesitancy among racial/ethnic and sexual minorities can identify potential reasons for disparities in vaccine coverage. Access and trust in medicine, healthcare, and vaccines themselves are common themes across the papers included in this section. These issues are central to understanding disparities in vaccine hesitancy and vaccine confidence and have been particularly salient during the COVID-19 pandemic. Addressing disparities in hesitancy and confidence that exist among minority groups and at-risk groups (e.g., grocery store workers during a pandemic) also revolve around increasing and maintaining trust and ensuring access to vaccines and healthcare. To address these health communication and intervention challenges, it is critical for researchers to understand the cultural and community contexts that influence beliefs and decisions about vaccines among different groups.

Four papers in the special issue report findings from studies using survey and qualitative methods to understand vaccine hesitancy (HPV and COVID-19) within the cultural contexts of different minority groups in the US. Garcia et al. (2023) report findings from qualitative interviews among Latina young adults from federally qualified health centers (FQHCs) in Orange County, Californina (US) to identify and understand barriers to HPV vaccine uptake among this population. The findings revealed barriers at the individual, interpersonal, and community levels. Specifically, themes emerged around low knowledge about the need for, or purpose of, HPV vaccines, concerns about vaccine side effects, risk perceptions, quality of provider communication and recommendation, familial cultural norms, access to quality care, and misinformation about the vaccines. Tsui et al. (2023) surveyed Hispanic/Latinx and Asian/Asian American parents in California (US) to understand adolescent HPV vaccine hesitancy. Similar to other findings, parents reported concerns about vaccine safety and side effects. In addition, perceptions of medical mistrust were associated with vaccine hesitancy, and hesitancy was associated with lower likelihood of vaccine uptake.

Weinstein et al. (2023) used a mixed-methods study to understand determinants of COVID-19 vaccine hesitancy and uptake among Latino sexual minority men. Findings revealed that accessibility factors (i.e., insurance status, financial stress) were associated with likelihood of getting the vaccine. Moreover, worry about others' health and fear of transmitting COVID-19 were positively associated with vaccine likelihood. Peña et al. (2023) report findings from a survey of several racial/ethnic groups (Latino/Hispanic, African American/Black, Asian American and Pacific Islander, Native American, White) to understand differences in COVID-19 vaccine hesitancy. First, Latino and Black respondents were less likely to be vaccinated. Second, accessibility factors (i.e., employment, health insurance) and perceptions of health inequalities in one's neighborhood, an interesting context factor, were associated with vaccination likelihood.

Two other papers report on activities from statewide initiatives in two different US states (Arizona and California) to better understand trust and communication strategies for

COVID-19 vaccines among different groups within each state. Ignacio et al. (2023) report findings from focus groups and surveys among African American/Black, Latinx, and Native people, in partnership with community organizations across Arizona (US). Mistrust in the medical system (historic and contemporary), importance of religious beliefs (among Latinx), and low trust in social media contacts emerged as key trust-related themes. Participants recommend messages from trusted sources (e.g., local officials, community members, faith leaders) to address trust and confidence in COVID-19 vaccines. AuYoung et al. (2023) report and describe the work of California's community-based alliance (STOP COVID-19 CA) to assess strategies, communication methods, languages, and trusted messengers to provide COVID information and promote vaccine uptake. The group employed various methods for gathering information from affected communities and stakeholders including workgroup meetings, virtual town halls with relevant communities, focus groups, surveys, and meetings with key partners (e.g., community advisory boards, faith leaders). They identified several key challenges including lack of infrastructure for inter-agency information sharing, difficulty communicating rapidly changing information, and combatting misinformation. The authors recommend that these challenges could be addressed in future pandemics or public health crises by developing community partnerships and using trusted messengers to increase trust in institutions.

The final two papers in this section address COVID-19 vaccine hesitancy among two other groups: grocery store workers, who became de facto frontline workers during the pandemic, and mothers, who tend to be primary decision makers about vaccination for children. Mayer et al. (2023) used data from the Arizona Frontline Workers Survey to examine COVID-19 vaccine hesitancy among grocery store workers. Confidence in vaccines and convenience of vaccination correlated with lower levels of vaccine hesitancy. Perceptions of one's employer keeping employees safe from COVID-19 was associated with increased vaccine hesitancy, a finding that illustrates the importance of understanding perceptions of workplace conditions and context. In a secondary analysis of survey data on social media misinformation among mothers, Waring et al. (2023) examined COVID-19 vaccine hesitancy among mothers, who tend to be the primary decision-makers about vaccination for children. They report that Black mothers were more vaccine hesitant compared to White mothers and that education levels were associated with hesitancy.

Social media and conspiracy beliefs

Seven papers in this special issue address issues related to conspiracy beliefs and the influence of social media on vaccine hesitancy and vaccine confidence. Over the past several years, social media platforms have been identified as major sources of misinformation about vaccines. The ease with which false and misleading information can be posted and rapidly disseminated around the world makes it difficult to address. Although many social media platforms have instituted protocols to reduce misinformation about vaccination, the problems with vaccine misinformation persist.

Two papers specifically address vaccine conspiracy beliefs in Hungary (Biro-Nagy et al., 2023) and Italy (Mignemi et al., 2023). Biro-Nagy et al. (2023) conducted a survey with adults in Hungary and identified several COVID-19 conspiracy beliefs, many of which were associated with vaccine hesitancy. Most prominent of these were beliefs that microchips are in the vaccines, vaccination is an effort at population control, and the virus is not real. As the authors note, hesitancy about COVID-19 vaccination is, in part, rooted in a lack of trust in health experts and health systems. The authors also identified that political affiliation also played a substantial role in hesitancy and confidence. Similarly, in their two-wave longitudinal COVID-19 survey of adults in Italy, Mignemi et al. (2023) report that conspiracy beliefs about COVID-19 negatively affected satisfaction with medicine and science, which, in turn, reduced vaccine confidence. In fact, they found that satisfaction with medicine and science fully mediated the association between conspiracy theories and vaccine confidence. In a similar vein, the article by Kohler and Koinig (2023) examines the effect of political beliefs and science-related populism (i.e., science skepticism) on vaccination decision-making among adults from Germany and Austria. Results from this survey study showed that stronger science-related populism beliefs were associated with COVID-19 and Measles, Mumps, and Rubella (MMR) vaccination, but not with several other vaccines (i.e., tick-born encephalitis, meningococcal, seasonal influenza, and human papillomavirus). The authors suggest that wide-spread media coverage in Germany and Austria of COVID-19 and MMR vaccines may explain why these vaccines, in particular, were associated with science-related populism. They also hypothesize a connection between anti-vaccination efforts and right-wing populist movements. These three studies point to the importance of developing programs and communication strategies to restore trust in science, medical experts, and government.

The remaining four articles in this section cover different aspects of social media influences on vaccine hesitancy and confidence. Manganello et al. (2023) examined COVID-19 and HPV vaccination attitudes and behaviors, with a particular focus on community type (i.e., rural, suburban, urban). Based on a survey of U.S. parents of children ages 9–14 years, they found that social media use was associated with vaccine confidence/intention/uptake, but only in unadjusted models. Other findings of note were that HPV vaccine confidence did not differ by community, but parents in rural

communities had lower confidence, intention, and uptake of COVID-19 vaccines. Consistent with the articles described in the previous paragraph, Manganello et al. found that political affiliation explained most of the variability in COVID-19 and HPV vaccine confidence, intention, and uptake. They suggest that social media messaging needs to be carefully designed to take into consideration the power of political identity, while at the same time finding ways to depoliticize communication about vaccine safety and efficacy.

Kornides et al. (2023) conducted a content analysis of English language Tweets associated with HPV vaccine, finding that nearly one quarter of the Tweets involved disinformation or misinformation (e.g., false claims regarding adverse health effects and of vaccine inefficacy), while the majority of Tweets were supportive or educational regarding HPV vaccination. Although misinformation Tweets were less frequent, they were much more frequently retweeted and had more engagement from viewers than supportive Tweets. The authors propose development and testing of interventions that could help to neutralize the impact of false claims on Twitter, including prebunking and debunking messaging. Weinzierl et al. (2023), using a unique, sophisticated multi-step approach to Twitter analysis, sought to characterize HPV and COVID-19 vaccination hesitancy and confidence profiles. They note that their innovative methodology enabled them to capture the heterogeneous sets of attitudes that make up vaccine hesitancy and confidence profiles and discuss the implications for more effectively tailoring health messaging based on the identified profiles.

Using an online survey with U.S. adults, Herzog et al. (2023) conducted a messaging intervention experiment focused on COVID-19 vaccination, with messages created to mimic social media profiles and posts. The primary outcome of interest was COVID-19 vaccine intentions. The authors found that exposure to social media profiles characterized by cautious comparison models (i.e., pro-science and socially conscious) resulted in increased vaccination intention compared to risky (i.e., focused on personal freedom and skepticism) or neutral models. They discuss the way in which their research findings could inform social-media-based communication messaging to decrease COVID-19 vaccine hesitancy and increase intentions to get vaccinated.

Interventions to promote vaccination

Effective and scalable interventions are critical to addressing vaccine hesitancy. The need for effective intervention strategies and multi-level intervention approaches (i.e., mass communication to clinic-based interventions) has become particularly salient during the COVID-19 pandemic. As newer vaccines are developed to protect against evolving viruses and variants, there will continue to be urgent need for effective communications strategies about the new vaccines and boosters, interventions to encourage and promote booster doses, and effective ways to disseminate the vaccines, particularly to underserved populations. Moving forward, it will be important for researchers and public health officials to learn from the successes and failures of different communication strategies and intervention approaches implemented for the initial COVID-19 vaccines. This is not an easy task. For example, rigorously evaluating intervention strategies for COVID-19 vaccines presents unique challenges for researchers given the need to account for rapidly changing secular trends in messaging about the vaccines and vaccination rates themselves. Although challenging, the current COVID-19 context presents opportunities for methodological innovations in testing and evaluating interventions that can not only benefit research on COVID-19 vaccines and boosters but advance research on interventions for vaccine hesitancy in other contexts.

The special issue includes five papers that report findings from message-based interventions to promote vaccination. Three of the interventions target COVID-19 vaccinations and the other two were conducted in the context of HPV vaccination. The papers report the effects of different intervention approaches that, in some cases, are potentially scalable and adaptable to other vaccine contexts. In all cases, the papers raise important issues that are central to future intervention design and evaluation to address vaccine hesitancy.

How to effectively persuade individuals who are hesitant about COVID-19 vaccines to decide to get the vaccine is an important and ongoing challenge. Two papers report tests of intervention approaches designed to increase message acceptance and decrease resistance to persuasive appeals about COVID-19 vaccines. Huang and Green (2023) tested a novel integration of narrative messages and self-persuasion to promote COVID-19 vaccination intentions among African-Americans. Participants read a personal narrative of an individual who was initially hesitant about vaccination but changed their mind after careful consideration (i.e., self-persuasion). This self-persuasion narrative combination led to greater vaccination intentions and lower perceived threat to autonomy than narrative messages or a self-persuasion condition alone. The self-persuasion narrative was also more effective among individuals with lower trust in science. Li et al. (2023) tested a self-affirmation intervention among Chinese individuals in which participants self-affirmed on important cultural values prior to reading a message promoting COVID-19 vaccination. The brief intervention led to greater vaccination intentions that were mediated by message acceptance. Narrative self-persuasion and self-affirmation are both intervention approaches that are scalable and adaptable to different vaccine contexts.

Political messaging and political identification about COVID-19 vaccines have also been influential in affecting

hesitancy and uptake in the US and other countries, as reported by other papers in this special issue (Biro-Nagy et al.; Kohler & Koinig; Manganello et al.). Sylvester et al. (2023) addressed the issue of political messaging around COVID-19 vaccines by testing a messaging approach in which participants read messages promoting COVID-19 vaccinations from co-partisan figures (i.e., political figures from one's own party) versus messages from celebrities. The co-partisan messages positively affected vaccination intentions among middle-of-the-road partisans from both US political parties (i.e., Democrats, Republicans) but had no effect for those who reported strong or weak partisanship. Given the effect of political identification in hesitancy about COVID-19 vaccines, how to effectively target individuals with strong and weak political identifications will be an important question for researchers to address.

In two studies, Reno et al. (2023) and Reno and Dempsey (2023) report findings from two interventions to promote HPV vaccination among Latinx individuals: one a culturally-targeted, fear-appeal message intervention and the other using an individually-tailored website. The fear-appeal messages focused on cancer prevention and genital warts prevention were effective in influencing information seeking intentions but had no effects on vaccination intentions. The tailored website had no clear effect on vaccination intentions. These findings demonstrate boundary conditions of some message-based interventions.

Conclusion

The articles included in this special issue of Journal of Behavioral Medicine reflect the complexity and multi-level determinants of vaccine hesitancy and vaccine confidence. Moreover, they point to the importance of considering all levels of the SEM when studying vaccination decision-making and designing and evaluating behavioral interventions. Vaccination has the potential to substantially reduce health disparities related to vaccine-preventable infectious diseases with strong vaccination policies, easy accessibility to vaccination, and low levels of hesitancy. However, as illustrated in several of the papers in this special issue, logistical and attitudinal barriers, particularly in the context of poor communication, poor policy, and a history of mistrust in medicine, science, and government, can increase rather than decrease disparities. Moreover, social media and the widespread dissemination of conspiracy theories, addressed in several papers, can amplify mistrust, polarization, and politicization of vaccination. This remains an issue about which we need to learn more, including identifying interventions to counter the negative effects of social media.

Trust, or the lack of trust, is a central factor underlying many of the issues covered in the papers included in the special issue. Restoring and maintaining trust in vaccination will require ongoing efforts across the SEM, including national, local, and organization policy changes, mass communication approaches, interventions targeted to healthcare providers, and interventions directed towards communities, as well as parents and other vaccine decision-makers. Social and behavioral scientists have a central role to play in all these efforts, including helping policy-makers design and communicate about policy decisions. The papers in this special issue showcase the many ways in which social and behavioral science can contribute to the understanding of vaccine hesitancy and improve vaccine confidence and uptake. As we have learned from multiple experiences (e.g., with HPV and COVID-19 vaccines), developing vaccines and making them available are necessary steps, but often entirely insufficient for achieving equitable and widespread vaccination coverage.

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